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Ultrasonographic Evaluation of Placental Sites and Thickness at Second Trimester and Its Correlation with Pregnancy Outcome

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ABSTRACT

Background: Adverse fetal outcome has a wide spectrum of perinatal mortality and morbidity as low fetal Apgar score, admission to NICU, low birth weight, stillbirth & maternal morbidity, and mortality. The use of ultrasonography of placental sites and thickness is the most effective method to estimate the adverse pregnancy outcome. **Objective**: To investigate the relationship between placental sites, diameter, and thickness at the second trimester with pregnancy outcome. **Patients and Methods:** the current study was conducted at the Obstetrics & Gynecology Department in Shibin El Kom Teaching Hospital, on 200 pregnant women with a single fetus presenting for routine antenatal care in the second trimester, from September 2016 to August 2017. Detailed history, laboratory investigations, obstetric and ultrasound follow up study was done. **Results:** The mean age of all patients was 27.54±5.03 years old. Placental sites were associated with placenta previa, placenta abruption, bleeding, FGR, and preterm delivery. Also, the placental diameter was highly related to placenta previa, placental abruption, bleeding and positively correlated with age and body mass index. Regarding, the placental thickness, it was highly associated with macrosomia and negatively correlated with age, and positively correlated with GA.
Conclusion: Placental implantation at the 18th to 24th weeks can be used as being at risk for adverse outcomes. Low placental implantation sites are associated with higher frequent preterm (labor & deliveries) and lower postpartum hemorrhage. High lateral placental implantations are associated with lower Apgar scores.
Keywords: Placental site, Pregnancy outcome, Thickness, Second trimester, Ultrasonography.

INTRODUCTION

A detailed ultrasound for fetal anatomy is now routinely studied on most pregnant in the USA. Also, the evaluation of fetal anatomy, an assessment of the uterus placental implantation site, and its association with the internal cervical OS is noted [(1)]. Ultrasonography is the preferred technique for placental localization. If a woman comes for the first time at term, even then a preliminary ultrasound examination for placental location is mandatory. One of the reasons for repeating the examination at the beginning of the third trimester is to determine the location of the placenta if it was described as a placenta previa at the mid-pregnancy examination [(2)].

Pregnant women with placenta previa were found to had decreased risk of hypertensive disorders as compared with normally implanted placentas [(2)]. While, unilateral placental implantations have been associated with a higher incidence of preeclampsia, fetal distress in labor, abdominal deliveries, and intrauterine growth retardation [(3)]. The placenta is a fetal organ that provides the physiologic link between a pregnant woman and the fetus. The placenta develops from the chorionic villi at the implantation site at about the fifth week of gestation and by the ninth or tenth week, the diffuse granular echotexture of the placenta is apparent at sonography [(4)]. Recently, two-dimensional (2D) placental measurements have exhibited potential utility for predicting adverse outcomes in certain high-risk patients, possibly by serving as a marker of normal chorionic regression and placental growth [(4)].

Second-trimester placental volumes measured by three-dimensional ultrasound have been used to identify fetuses at risk of growth restriction, while another study reported that ultrasonographic measurement of placental diameter and thickness is of prognostic value in identifying the subsequent occurrence of fetal growth restriction [(5)]. This prediction of growth-restricted pregnancies from placental size is based on the fact that diminished placental size precedes fetal growth restriction [(6)]. The aim of this study was to determine the utility of two-dimensional (2D) sonographic placental location and measurements in the prediction of adverse pregnancy outcome.

PATIENTS AND METHODS

This observational cohort study was conducted at the Obstetrics & Gynecology Department, Shibin El Kom Teaching Hospital, Menoufia, Egypt on 200 pregnant women with a single fetus presenting for routine antenatal care in the second trimester (between 18 and 24 weeks' gestation) from September 2016 to August 2017.

Ethical Considerations: All participants were volunteers. All of them signed written informed consent with explaining the aim of the study before the study initiation. **Approval was obtained from the ethical committee at the Faculty of Medicine, Menoufia University.**

Inclusion criteria: pregnant women with a single fetus presenting for routine antenatal care in the second trimester (between 18 and 24 weeks' gestation).

All the recruited women underwent ultrasonic placental localization and measurements and were followed via regular antenatal care visits in the outpatients' clinic to record obstetric outcomes.

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Placental localization: 10 distinct placental implantation sites were identified based on previous investigations assessing placental migration.

Placental measurements (diameter & thickness) as follows:

(i) Scanning through the placenta from various angles to obtain the largest diameter possible; (ii) Measurement of the diameter along the fetal surface using a linear or bilinear approach (whichever is deemed a better fit); (iii) Measurement of the largest placental thickness in the same image; (iv) Rotating of the probe 90° and scan to find the largest diameter in that plane; (v) repeat the same diameter and thickness measurement.

Outcomes considered: included the followings;

Placenta previa: Placenta previa is a low-lying placenta that covers part or all the Internal of the cervix.

Placental abruption: Placental abruption (sometimes called abruptio placentae) is a condition in which the placenta peels away from the uterine wall, partially or almost completely, before delivery.

Any bleeding during pregnancy, (APH –PPH):

In obstetrics, antepartum hemorrhage (APH), also hemorrhage, is genital bleeding during pregnancy from the 28th week (sometimes defined as from the 20th weeks' gestational age to term. Preterm labor (uterine contractions with cervical change), Preterm birth, also known as premature birth, is the birth of a baby at fewer than 37 weeks gestational age.

For all patients, the following procedures were performed:

- Careful history taking: e.g. high lighting age, parity, gestational age.
- Careful taking past history: for any medical disorder during previous pregnancies for multiparous women poor obstetric outcomes as FGR, IUFD, GDM, PE...etc.
- Family history: for hypertension, and diabetes mellitus.
-

General examination:

Initial visit (18-24 weeks)

A. Clinical examination: e.g. weight body mass index (BMI) was calculated (weight in kilograms divided by the square of height in meters), blood pressure, edema, and fetal heart sounds auscultation.

B. Laboratory investigation: including

- Detection of microalbuminuria by dipstick testing after asking the patient to bring a morning mid-stream sample on the day of examination. The presence of albumin is confirmed by 24 hours urine and a value of 300mg/ 24 hours urine is diagnostic of proteinuria.
- Fasting blood sugar normally from 70-110 mg/dl 2 hours post prandial up to 140 mg/dl, using Sysmex KX-21 automatized hematology analyzer (Sysmex Corporation, Japan). As well as Glycated Hb in indicated cases, ≤6.5 was diagnostic of DM.
- Assessment of BPD, FL correlated to gestational age. Also, Measurement of placental thickness, diameters, sites & Grading.
- Obstetric and Ultrasound follow up study (18-24 Wks): was done by a device (EM-2000, SHENZHEN electronic technology, co; LTD -tian Nanyou-Ind Area-Shenzhen 518054).

Statistical Analysis

Results were analyzed and tabulated using Microsoft Excel version 7 (Microsoft Corporation, NY, USA) and SPSS v. 16. (SPSS Inc., Chicago, IL, USA). Two types of statistics were done: Descriptive: e.g. Percentage (%), mean, median, and SD. Analytical: includes: Chi-Squared (χ^2), Wallis analysis of variance for comparing categorical data, and Person correlation coefficient (r) for correlation between two dependents quantitative not normally distributed variable. A value of $P < 0.05$ was indicated statistically significant.

RESULTS

Table (1): Demographic and clinical data of the studied patients (n=200)

Clinical data	Studied patients (n=200)	
	Mean ±SD	Range
Gestational age (GA)	21.5±7.2	16 – 33
Age (years)	27.54±5.03	18-39
Body mass index (kg/m2)	28.95±8.12	20-34
Placental diameter (cm)	12.16±1.42	6-18
Placental thickness (cm)	2.71+0.33	1.5-6
Parity:	No	%
Primigravida	20	10.0
Multigravida	180	90.0
Placental site:		
high posterior	17	8.5
left high	28	14.0
right low	8	4.0
left low	9	4.5
central	7	3.5
high anterior	24	12.0
low anterior	31	15.5
fundal	25	12.5
right high	33	16.5
fundal anterior	4	2.0
fundal posterior	4	2.0
low posterior	10	5.0

SD: Stander deviation, FGR: Fetal Growth Restriction RH: Rhesus PPH: Postpartum hemorrhage DM HTN: Diabetes mellitus, hypertension APH: Antepartum hemorrhage

This table shows that the age of the patients ranged from 18-39 years with a mean of 27.54±5.03 years old. Also, the mean BMI and gestational age of the patients were 28.95±8.12 (range; 20-34) and 21.5±7.2 (range; 16-33) respectively. Ten percent of patients had primigravida and 90% had multigravida. Prior uncomplicated pregnancy recorded the most frequency (9.5%), Also, the mean of placental diameter and thickness were 12.16±1.42 (range: 6-18) and 2.71+0.33 (range:1.5-6) respectively. Regarding placenta site, there was 16.5% right high;15.5% low anterior; 14% left high and 12.5% fundal (Fig 1-6).

Table (2): The relations between placental sites and adverse pregnancy outcomes

Pregnancy outcome		Placental Sites						$\chi 2$	P-value
		Fundal		Lateral		Low			
		No	%	No	%	No	%		
Placenta previa	No 161	64	39.0	54	32.9	46	28.04	6.54	0.032
	Yes 36	10	27.8	8	22.2	18	50		
Placental abruption	Yes 14	11	60.0	2	26.7	2	13.3	9.18	0.010
	No 183	63	34.1	60	32.4	62	33.5		
(APH-PPH)	No 158	70	43.5	47	29.9	44	27.3	15.86	0.0003
	Yes 39	4	10.2	15	38.5	20	51.3		
Preterm contraction	No 192	73	37.4	59	30.3	63	32.3	2.023	0.364
	Yes 5	1	20	3	60.0	1	20.0		
FGR	No 176	72	40.2	58	32.4	49	27.4	17.2	0.001
	Yes 21	2	9.5	4	19.1	15	71.4		
Abnormal presentation	No 184	70	37.4	58	31.3	59	31.6	0.238	0.849
	Yes 13	4	30.8	4	30.8	5	38.5		
Postpartum hemorrhage	No 183	69	37.1	60	32.3	57	30.6	2.88	0.236
	Yes 14	5	35.7	2	14.3	7	50.0		
Macrosomia	No 185	67	35.6	60	31.9	61	32.4	2.61	0.271
	Yes 12	7	58.3	2	16.7	3	25.0		
Preeclampsia	No 179	71	39.0	56	30.8	55	30.2	9.5	0.008
	Yes 18	3	16.6	12	66.6	3	16.6		
Preterm delivery	No 176	70	39.1	57	31.8	52	29.1	7.07	0.029
	Yes 21	4	19.1	5	23.8	12	57.1		

X^2: chi-square APH-PPH: Antepartum: Postpartum hemorrhage FGR: Fetal Growth Restriction

Table (2) shows that placental sites were associated with placenta previa (x^2=6.54, p=0.032), placenta abruption (x^2=9.18, p=0.010), bleeding (APH, PPH) (x^2=15.86, p=0.0003), FGR (x^2=17.2, p=0.001), preeclampsia (x^2=9.5, p=0.008) and preterm delivery (x^2=7.07, p=0.029). While, no significant relation (P >0.05) was observed between placental sites and preterm contraction, abnormal presentation, postpartum hemorrhage and macrosomia.

Table (3): The relation between placental diameter and pregnancy outcome.

Pregnancy outcome		Placental diameter		Mann-Whitney Test	P-value
		Mean ±SD	Range		
Placenta previa	No 161	12.82± 2.472	7-20	3.2	0.0001
	Yes 36	14.8±6.222	9-20		
Placental abruption	Yes 14	11.17±1.88	7-14	1.96	0.049
	No 183	12.91±2.438	7-20		
Bleeding (APH-PPH)	No 158	12.95±2.356	7-20	2.206	0.027
	Yes 39	12.28±2.645	8-20		
Preterm labor	No 192	12.81±2.435	7-20	0.173	0.863
	Yes 5	12.9±2.133	10-15		
FGR	No 176	12.79±2.492	7-20	0.552	0.581
	Yes 21	13.03±2.423	7-20		
Abnormal presentation	No 184	12.81±2.383	7-20	0.127	0.899
	Yes 13	12.86±3.043	8-18		
Post-partum hemorrhage	No 183	12.79±2.42	7-20	0.859	0.39
	Yes 14	13.11±2.423	7-17		
Preterm delivery	No 176	12.86±2.484	7-20	0.979	0.327
	Yes 21	12.46±1.845	10-17		
Age				0.242	0.001*
BMI				0.149	0.036*
Gestational age				0.035	0.630

APH-PPH: Antepartum: Postpartum hemorrhage FGR: Fetal Growth Restriction BMI: body mass index

*: significant correlation at p<0.5 level

Table (3) shows that placental diameter was positively correlated with age (r=0.242, p=0.001) and body mass index (r=0.149, p=0.036), placenta previa (p=0.0001), placental abruption (p=0.049), and bleeding (p=0.027). But not correlated (P>0.05) with gestational, preterm labor, FGR, abnormal presentation, post-partum hemorrhage, and preterm delivery.

Table (4): The relation between pregnancy outcome and placental thickness.

Pregnancy outcome		Placental thickness		Mann-Whitney Test	P-value
		Mean ±SD	Range		
Placenta previa	No =163	2.553±0.67	1.2-6.0	0.366	0.715
	Yes =36	2.481±0.55	1.8-5.0		
Placental abruption	No= 184	2.54 ±0.67	1.2-6.0	0.181	0.856
	Yes=15	2.427±0.39	1.5-3.0		
Bleeding	No =160	2.521±0.62	1.2-6.0	0.633	0.527
	Yes =39	2.62±0.75	1.5-5.0		
Preterm labor	No =194	2.54±0.65	1.2-6.0	0.41	0.68
	Yes =5	2.50±0.46	2.0-3.0		
FGR	No =178	2.54±0.68	1.2-3.0	9.5	0.001*
	Yes =21	4.2± 1.33	1.5-6.0		
Abnormal presentation	No=186	2.52±0.64	1.2-6.0	0.95	0.34
	Yes=13	2.70±0.753	2.0-4.4		
Preterm delivery	No=178	2.55±0.67	1.2-6.0	0.29	0.77
	Yes=21	2.40±0.37	1.5-3.0		
Postpartum hemorrhage	No=185	2.53±0.66	1.2-6.0	1.05	0.29
	Yes=14	2.64±0.54	1.8-4.0		
Age				-0.180	0.011*
BMI				0.021	0.770
Gestational age				0.260	0.001*

SD: stander deviation FGR: Fetal Growth Restriction BMI: body mass index
*: significant correlation at p<0.5 level

Table (4) shows that placental thickness wasn't correlated (p >0.05) with placenta previa, placental abruption, bleeding, preterm labor, abnormal presentation, preterm delivery, postpartum hemorrhage, and body mass index, while negatively correlated with age (r= -0.180, p=0.011). Also, positively correlated with FGR (x^2=9.5, p=0.011), (x^2=9.4, p=0.001) and gestational age (r=0.260, p=0.001).

Fig 1: Primigravida + 23 weeks, site left high thickness 3.66cm, diameter 7.4cm

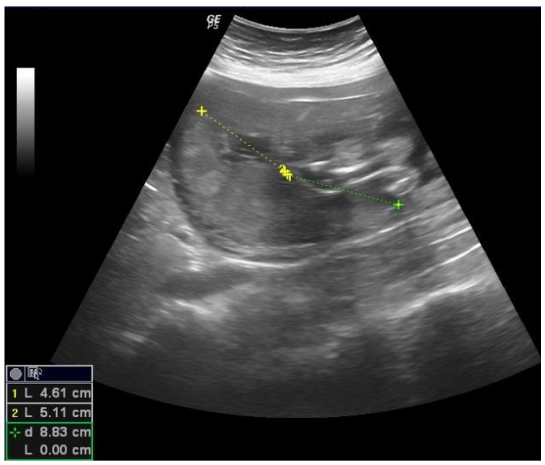

Fig 2: G3 P2 +0 + 23 weeks previous two sections, site right high, thickness 3.22cm, diameter 4.6cm x 5.11cm

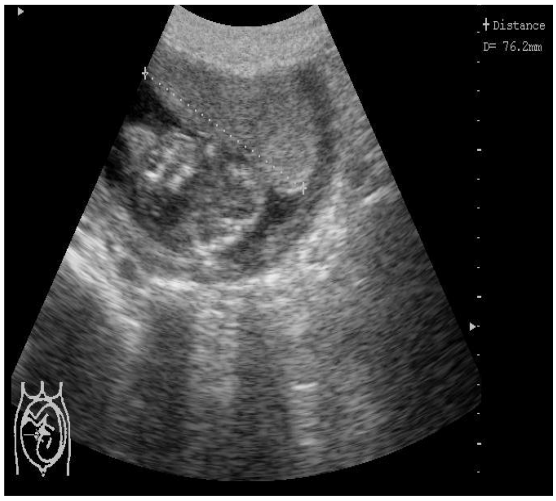

Fig 3: G2 P1 +0 + 18 weeks previous one section Site fundal anterior, thickness 3.59cm, diameter 7.62cm

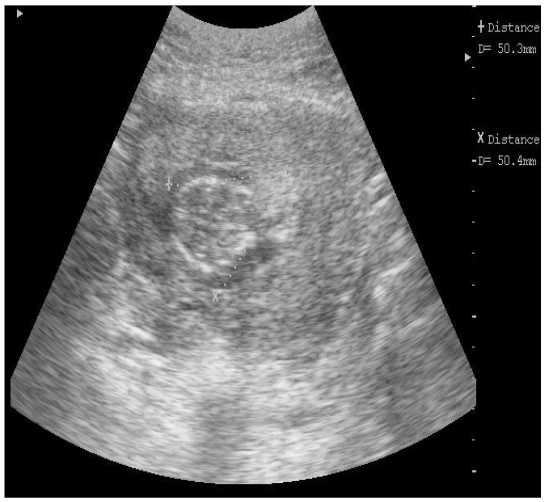

Fig 4: G4 P3 +0 + 23 weeks previous three sections, site anterior high thickness 3.84cm, diameter 5. 3cm x 5.4cm

Fig 5: G4 P3 +0 + 23 weeks previous three sections, site anterior high, thickness 3.84cm, diameter 5. 3cm x 5.4cm

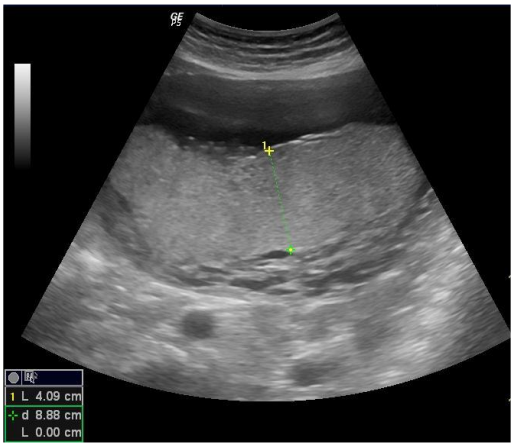

Fig 6: G3 P2 +0 + 24 weeks two normal vaginal delivery, site posterior low, thickness 4.09cm, diameter 13.35cm

DISCUSSION

Although multiple well-written texts are available on the pathology of the placenta, few sources specifically focus on the normal development and anatomy of this complex organ [(7)]. So, the purpose of this study was to determine the utility of two-dimensional (2D) sonographic placental location and measurements in the prediction of adverse pregnancy outcome. This observational cohort study was conducted on 200 pregnant women with a single fetus presenting for routine antenatal care in the second trimester (between 18 and 24 weeks' gestation) to determine the utility of two-dimensional (2D) sonographic placental location and measurements in the prediction of adverse pregnancy outcome.

In this study mean age of patients was 27.54±5.03 years old. While mean BMI and gestational ages were 28.95±8.12kg/m^2 and 21.5±7.2 years, respectively. Ten percent of patients had primigravida and 90% had multigravida. Also, the mean placental diameter and thickness were 12.81±2.423 and 2.54±0.6542, respectively. Regarding placenta site, there was 16.5% right high; 15.5% low anterior; 14% left high and 12.5% fundal. Consistent with our findings, **Adhikari *et al.*** [(8)] found that the age of patients ranged between 17 years to 35 years. The mean age was 22.64 years and an SD of 3.30. The minimum gestational age was 11.57 weeks and the maximum gestational age was 40.00 weeks with a mean gestational age of 25.49 weeks and an SD of 8.00. While mean of Placental thickness in mm was 21.83±0.19. Additionally, thousand Saudi pregnant women were examined using ultrasound by **Babiker and Eisa** [(9)], they found that patients ages were 16 to 45 years, the mean was 29 years old. Gestational ages (GA) of their fetuses were from (12th -40th) weeks. 21.9% of the participants were primigravida (PG). The mean GA was 38.1± 0.89 and the mean placental thickness was 39.6 mm ± 7.0.

Moreover, **Schwartz *et al.*** [10] found that maximal placental thickness was significantly related to FGR where the mean of placental thickness was 2.9 ± 0.6. Also, **Ohagwu *et al.*** [11] showed that the maximum mean placental thickness of 45.09 ± 6.37 mm was recorded at the 39 weeks of gestation, this is exceeded the current study results which suggested that the maximum mean placental thickness in the group (37th -40th) weeks was 39.6 ± 7.0 mm. While **Sadler** [12] showed that the maximum placental thickness of 45.10 + 6.37mm was recorded at 39 weeks of gestation while the maximum estimated fetal weight was recorded at 41 weeks. It is possible that while the fetus continues to gain weight up to 41 weeks there is a fall in the placental increase in thickness at term.

Also, **Stamnes Koepp *et al.*** [13] found that mean pre-pregnancy BMI was 24kg/m^2 (SD 4.3), mean maternal weight change in the first 30 weeks of gestation was 9.3kg (SD 4.4), mean birth weight was 3675g (SD 487) and mean age 30.3 years. **Afrakhteh *et al.*** [14] found that the mean age of cases was 26.4±5.1. Values of mean birth and placental weights were 305.56±657.0 and 551.7±104.8 grams respectively. Mean±SD of gestational age was 268.2±22.3 days. The percentage of macrosomia (>4,000 g) and low birth weight (<2,500 g) neonates at delivery were 2.5 and 14.6% respectively. Ultra-sonographic measures of placental thickness in the second and third trimester and changes between them were 21.68±4.52, 36.26and 14.67±5.67 mm respectively, (14). It connects to the fetus by an umbilical cord of appr±6.46, proximately 55-60 cm (22-24 in.) in length at term with a diameter of 2.0 to 2.5 cm [15].

The current study showed that placental sites were correlated with placenta previa, placenta abruption, bleeding (APH, PPH), FGR, and preterm delivery, and not correlated with preterm contraction, abnormal presentation, and postpartum hemorrhage. These results agree with several studies, **Magann *et al.*** [16] found that placental sites not correlated with pregnant ages (p=0.605) and macrosomia (p =0.271). **Seadati *et al.*** [17] found that Low placental location was associated with increased risk of preterm labor and preterm delivery. **Jang *et al.*** [18] indicated that placental sites weren't correlated with maternal age (p=0.073), and gestational age (p=0.058). **Shumaila** [19] found that the anterior placenta was found to have a relation with placental abruption (p<0.001), while the posterior placenta had a significant association with preterm labor (p<0.001). **Triunfo *et al.*** [20] **and Benton *et al.*** [21] suggested that an association between FGR and placental sites in these pregnancies as indicated by the presence of significant placental pathology. **Sheiner *et al.*** [22] found an association between placenta previa and preterm delivery, cesarean sections, and placental abruption.

In contrast, our results disagree with **Magann *et al.*** [16] who found that no relation between placental sites and placental abruption (p=0.10), bleeding (p=0.54). While that **Rosenberg *et al.*** [23] did not find such an association between placenta previa and placental abruption. The discrepancies between these studies may have resulted from differences in maternal background, the gestational period at diagnosis, or patient management.

In the present investigation, age, body mass index, placenta previa, Placental abruption, and bleeding were positively correlated with placental diameter, but not correlated (P >0.05) with gestational age, preterm labor, FGR, abnormal presentation, post-partum hemorrhage, and preterm delivery. These findings correlate with the study of **Das *et al.*** [24] who observed that the diameter of the placenta was less in hypertensive disorders and agreed with **Damodaram *et al.*** [25] found a reduced but positive correlation between the same association in growth-restricted fetuses. Similarly, a recent study by **Sharma and Gupta** [26] found that approximate gestational age in weeks does not correspond to placental diameter. The subnormal placental diameter for age may be the earliest indicator of growth restriction. While, **Gilbert-Barnass *et al.*** [27] found that clinically the abnormality presents with vaginal bleeding, in the second or third trimester or during labor, due to an associated placenta mebrenaca. Ultrasound has been used to detect this condition which found increased placental diameter.

In the current study, the placental thickness was positively correlated with FGR, gestational age, and negatively correlated with age, but not correlated with body mass index. Consistent with our findings, **Ohagwu *et al.*** [11] conducted a study to determine the relationship between placental thickness and gestational age and found that there is a linear increase in mean placental thickness with gestational age. Similarly, a recent study by **Mital *et al.*** [28] had reported that up to 21 weeks, the mean placental thickness was slighter higher than the gestational age (1-4mm). **Karthikeyan *et al.*** [29] found a strong positive correlation between placental thickness and gestational age. **Jain *et al.*** [30] found placental thickness (mm) almost matched gestational age (weeks) from 27 weeks to 33 weeks of gestation. Similarly, in a recent study by **Elchalal *et al.*** [31] a linear increase of placental thickness was found to correlate with gestational age throughout pregnancy. **Schwartz *et al***. (10) found that maximal placental thickness was significantly related to FGR (p-value 0.015) where the mean of placental thickness was 2.9 ± 0.6. Also, **Raio *et al.*** [32] found that there was no significant correlation between placental thickness and abruption placenta (p=0.856).

CONCLUSION

Placental implantation at the 18th to 24th weeks can be used as being at risk for adverse outcomes. Low placental implantation sites are associated with higher frequent preterm (labor & deliveries) and lower postpartum hemorrhage. High lateral placental implantations are associated with lower Apgar scores.

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